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Learning to Elearn Case Study 1

EduArt and Cambridge University Press: Specialist Applications for the Hitachi Interactive Whiteboard

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1. Summary

EduArt and Cambridge University Press aimed to create a digital complement to the existing Spectrum Science Year 7 textbook module *7A.2 How Microscopes Help Change Our Ideas.* The digital content was intended to promote greater interest by the class as a whole, encourage weaker learners[†] to participate in the lesson and allow individual student and small group revision. The new digital content had to not only deliver all the original learning outcomes, but also present the original content in a dynamic and interesting way to maximise the overall interest of the class. Content had to be delivered in a pedagogically sound manner whether as teacher-led classroom learning (instructor-led training, or ILT), via the Internet or in the classroom with emerging classroom-based electronic learning technologies, particularly the Hitachi Cambridge Interactive Whiteboard.

Even though the digital version was based on the textbook's content and learning outcomes, the pedagogy had to consider the means of delivery and the student's mode of access. EduArt recognised that the redesign of the content had to address important pedagogical issues.

The ultimate result has been the development of one basic version of the software plus a variation, which adapted the graphic user interfaces and individual learning objects to address the different approach required for large-screen interactive whiteboard presentation.

2. The Elearning Challenge

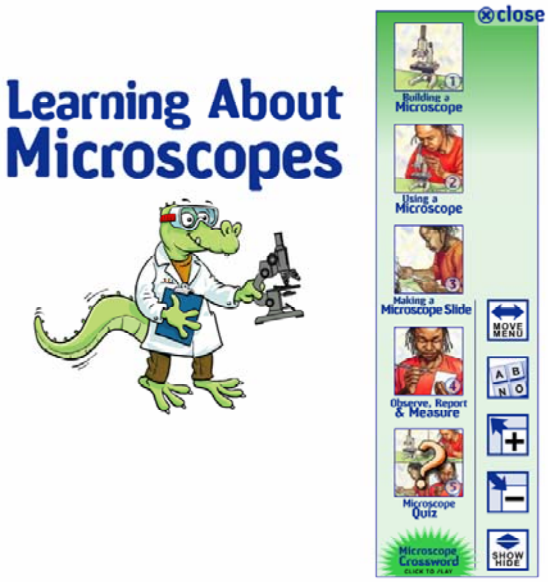
The Microscope Learning Module (*7A.2 How Microscopes Help Change Our Ideas*) became a pilot for development of elearning content that transferred classroom-based instruction not just into electronic environments, including if required, the Web, but also into emerging digital technologies designed specifically for use in the classroom, most notably the electronic interactive whiteboard or eboard technologies.

[+] When quoting this case study, use as reference: Steve Foskett and Marcus Bowles. (July 2003). *EduArt and Cambridge University Press: Specialist Applications for the Hitachi Interactive Whiteboard, Unitas Knowledge Centre: Learning to Elearn Case Study 1*. Hobart, Australia: Unitas Company Ltd.
[†]Note: Learner is used to refer to student, pupil, trainee or end user.

As part of an agreement to develop advanced elearning content and applications, Cambridge University Press provided the Microscope Learning Module to EduArt for 'digital' conversion. This module has been in use in the United Kingdom Stage 3 Science Curriculum.

The challenge confronting EduArt in the latest digital content development was to convert the existing small-screen module into an enhanced digital format that could be accessible via the Internet and be used in the classroom with the Hitachi Cambridge Interactive Whiteboard. It was essential for the content to deliver the required learning outcomes using a pedagogically sound approach.

Student Version Opening Screen
Specifically designed for small-screen monitors and individual learning.



Interactive Whiteboard Version Opening Screen
Specifically designed for large-screen displays and group learning.

3. Analysis of Elearning Strategy/Actions

EduArt had to address a number of parameters. (The most important of these are covered in-depth in the following sections.) These parameters include:

1. Learning outcomes;
2. Individual needs;

3. Content design;
4. Learning objects; and
5. Technology and infrastructure.

Learning Outcomes

The learning outcomes for the module *7A.2 How Microscopes Help Change Our Ideas* are:

All students should be able to:

- Recognise that all living things are made of cells; and
- Relate drawings to observations made using a microscope*.

Most students should also be able to:

- Describe the development of some ideas about the structure of living things;
- Use a microscope safely and effectively*;
- Prepare a simple slide*;
- Make observations and simple drawings from a microscope slide*; and
- Recognise scaling up and down*.

Some students will also be able to:

- Link the evidence from microscope work to changing ideas about the structure of living things;
- Compare and interpret information from microscopic observation; and
- Estimate the size of a specimen viewed under a microscope*.

(Outcomes with an asterisk [*] are directly covered by the Microscope Learning Module.)

The pedagogy had to address issues related to the new technology, including:

- Maintenance of class control and interaction in an environment not always designed for teacher-centred learning (instructor-led learning);
- Reliability of networks;
- Bandwidth available to different networks and locations;
- Blending of computer-based training and instruction with non-computer enabled activities; and
- Expertise of teacher and students in using the technologies.

Individual needs

The interactive whiteboards had to accommodate variables such as individual needs and situational differences. The technology, and therefore the interactive whiteboard version of the Microscope Module, had to be implemented differently in a classroom depending on such factors as:

- The age of the children being taught;
- The subject being taught (and whether an ICT subject);
- Class size;
- Classroom dynamics and type of class;
- Teacher ICT capability;
- Access to broadband Internet from the board;
- Physical set-up in the classroom;
- Type of digital projector and screen resolution;
- Type of computer used to operate the interactive whiteboard; and
- Physical size and type of interactive whiteboard.

Content design

The interactive whiteboard had to support functionality such as:

- Use of content with software such as Microsoft Office XP;
- Video presentation onscreen while completing instruction;
- Showing audiovisual presentations at the same time as using the whiteboard;
- Capacity to include screen notes in real time by participants in classroom or virtual settings;
- Touch-screen functionality;
- Delivery of automated pre-prepared lessons; and
- Allowing interaction with a whiteboard session by all participants, in the classroom or over LAN, WAN or Internet connections.

EduArt believed the vast majority of educational software for use in schools has been designed, and in some cases designed very well, for individual viewing on a small screen. Such screens usually are not touch-sensitive, are operated from a keyboard and mouse, and are linked to a single platform that may be part of a local area network. This software requires the undivided attention of the user, and by its very nature has to instruct the user in its operation. This often negates the role in the lesson of the teacher/instructor, who instead becomes more of a course coordinator, organising machines and networks rather than delivering individual and collective learning experiences.

EduArt also recognised that the revised Microscope Learning Module could be designed to assist students with different learning styles to achieve the learning outcomes. To assist differentiation of the types of learning and the pedagogy required for students using various means to access and interact with the digital content to attain knowledge, the Bloom Taxonomy of Educational Objectives (1956) was used (see Attachment 1). This 'taxonomy' separates out three main 'domains' of learning.

The taxonomy also promotes differentiation of levels of thinking and development of high-order thinking skills. Use of Bloom's taxonomy ensures that learning activities, content and assessment tools incorporate metacognitive instructional aspects into their design and implementation. This approach is particularly useful for the design of content to support any learning, physical or electronic.

To assist students with different learning styles to achieve the learning outcomes required, guidelines based on Multiple Intelligences Learning Theory and Emotional Intelligence were also applied. By providing illustrations, audio, animation, word games, puzzles and multiple choice tutorial quiz questions, the widest possible audience was catered for, thus bringing into the learning net students who due to poor reading skills or lack of interest tend to slip through the system and not attain the desired learning outcomes.

Learning objects

EduArt and Cambridge University Press recognised that the popular definitions of learning objects did not encompass the breadth required to describe the development of this module.

EduArt devised a two-tiered approach to defining learning objects. At the first tier there were simple learning objects (SLO). These included the most basic building blocks of the module or any content; for instance, the text, audio, visual, graphic, animations and other electronic components that form content (this could include such files as Flash™, Excel™ and PowerPoint™).

At the second tier were combined learning objects (CLO). This is where SLOs were grouped into meaningful instructional purposes. These included:

- Quizzes;
- Tutorials;
- Multiple choice exercises;
- Word search puzzles;
- Interactive exercises;
- Simulations; and
- Demonstrations.

Cambridge Learning Modules — the term coined for the concept — such as the Microscope Learning Module, would be formed from a collection of SLOs and CLOs systematically organised to address specific learning outcomes. These learning outcomes had to be clearly targeted and all learning objects (simple or complex) metatagged so that they could be retrieved and identified with respect to any well defined learning outcome.

The learning process also had to be individualised; that is, learning outcomes had to be managed to enable the teacher/instructor to determine whether all, most or some students had accessed the required learning object to achieve the required learning outcomes.

All assessments were metatagged. Metatagging identified what styles of learning or cognitive approaches were addressed by different exercises and how this supported different pedagogical approaches. Identifying different learning styles or cognitive approaches was important because the assessment had to reflect the individual learner's multiple intelligences and learning styles while still ensuring consistent attainment of the required learning outcomes. At the same time, assessment, including correct and incorrect answers, had to be presented as interactive exercises for one or many students. Further, the quizzes and exercises had to stimulate different cognitive and skill responses from each student.

Technology and infrastructure: the Hitachi Interactive Whiteboard

Launched in partnership with Cambridge University Press in early 2003, Hitachi's Cambridge Board is one of a range of products that advance elearning technology in the classroom. The Hitachi Cambridge Interactive Whiteboard is an example of electronic technology introduced to augment classroom learning, rather than restricting learning to virtual and online environments. The Hitachi Cambridge Interactive Whiteboard website suggests the following.

- The new Hitachi Cambridge Interactive Whiteboard is the most advanced interactive teaching resources available to educators, offering unparalleled durability, speed and accuracy. Linked to a PC and a data projector it can help build exciting, dynamic and inspirational lessons through its unique suite of software, which is easy to use and now fully customisable;
- Combined with a digital projector, the technology is a total audiovisual solution with Internet and virtual classroom applications, as well as an immediate integration point for teacher and class interaction; and
- Applications such as graph paper, music scores and remote conferencing are built into the new software suite, which will continue to be enhanced and updated to deliver the latest innovative features. All of this means more interested students — and better grades. To match its versatility, the 'Cambridge Board' can capture data faster than most people can write, so there are none of the delays inherent in some competitors' products, which can interrupt the natural rhythm of a teacher or classroom in full creative flow. Capturing pen strokes at around three metres per second at a resolution higher than most desktop printers, the Cambridge Board is the fastest and most accurate whiteboard available. The Cambridge Board is designed specifically for teaching environments. It is the toughest in its class, with robust electromagnetic technology, providing a screen that is very difficult to damage, even under the rigorous write/clean cycles of conventional whiteboard use.

Hitachi Interactive Whiteboards: Hitachi Cambridge

Specifications Hitachi CAMBO60-P Hitachi 60” or Hitachi CAMBO75-P Hitachi 75” Cambridge Board:

- Screen size: 60 to 75 inches
- Technology: Electromagnetic cordless
- Weight: 16.3 kgs
- Pen battery life: 200 hours approx
- Dimensions: 126 x 110 x 4.5 cm (W x H x D)
- Floor stand: Optional
- Wall mount: Optional
- Misc: Three-year on-site warranty

4. Implications for Elearning

This section aligns the EduArt and Cambridge University Press Specialist Applications for the Hitachi Interactive Whiteboard with the eight principles for elearning derived from Unitas’s initial Investigative Research Report.

Learning to Elearn Principle 1

> ***Elearning has maximum strategic impact when it is used to enhance both performance and thinking.***

Interactive whiteboards provide a rare opportunity for a dynamic shift in the use of technologies in the classroom. EduArt believes that interactive whiteboards will have an even greater effect on the classroom than the introduction of video and represent the biggest advance since computers became commonplace in schools. New technologies, however, are usually initially underutilised and their potential underestimated. With the right software, though, interactive whiteboards have the potential to revolutionise teaching practices and allow the better application of contemporary learning theory in everyday teaching practice. The educational and training software to be developed by the Launceston e-Learning Research and Development Centre will apply Bloom’s Taxonomy, emotional intelligence and multiple intelligences to engage as many students as possible and maximise knowledge transfer.

Learning to Elearn Principle 2

> ***Effective elearning occurs when technology and processes are built to enable improved individual learning. This includes responding to the changing interaction between the type of learning and knowledge, the situated outcomes sought and the individual's needs and preferences (including the designer, facilitator and user).***

EduArt has identified four types of elearning objects classified by educational functionality:

1. Teaching objects;
2. Revision objects;
3. Demonstration objects; and
4. Testing objects.

The objects are designed with definite types of learning and knowledge transfer required and outcomes sought. EduArt elearning objects take a variety of forms, such as Drag 'n Drops, crossword puzzles, word searches, tutorial quizzes, jigsaw puzzles and CLOZE exercises. EduArt has found that teacher and student understanding of what is possible and the function of elearning has not yet been clearly or well defined. Teacher and student expectations can vary greatly and quite often some are disappointed because their expectations are too high or they have misunderstood the purpose of the object. It is therefore of real value to quickly and accurately describe the object in terms of its primary function.

The primary functions of each of the four types of objects are set out below.

Teaching Objects provide new content and undertake to have the student learn independently of the teacher. This type of object may assume some prior knowledge and be used for extension work or as an introduction to a new topic. Typically Teaching Objects instruct and guide the student through a series of steps or scenes. The two Learning Objects 'Making a Microscope Slide' and 'Observe, Report and Measure' have aspects that make them Teaching Objects.

Revision Objects provide the user with the opportunity to review content already learnt and practise concepts with immediate feedback. Revision Objects do not require the quantity of instruction found in the Teaching Objects and require only minimal instruction to complete the exercise. The 'Using a Microscope' object and the 'Microscope Crossword Puzzle' are both good examples of Revision Objects.

Demonstration Objects typically illustrate an experiment or process using animation or sped-up photography. They add a dynamic dimension by providing the student with a fuller explanation of the experiment or process than would be possible from a textbook. The 'Observation' section of 'Using a Microscope' is an example of a Demonstration Object, though more typically a Demonstration Object would be an animation of an experiment such as filtration or a demonstration of a heart beating and circulation.

Testing Objects provide the opportunity for students to try out their newly acquired knowledge or prepare for a test. Typically a Testing Object would be composed of a series of (self-assessment) quiz questions, a crossword puzzle or a Drag 'n Drop exercise. The 'Microscope Quiz' is a Testing Object and Scenes 3 and 4 of 'Reporting and Measuring' are 'Testing Objects.

Learning to Elearn Principle 3

> ***Elearning is both a process of learning and a means for achieving knowledge transfer.***

As noted in Principle 1, interactive whiteboard technology represents the return to the classroom of the best of electronic technologies while still accessing PC and Internet capacity. By selecting from a variety of styles and applications in the same lesson, a group representing diverse individual learning styles can access the technology relevant to their preferences and achieve learning outcomes in a variety of ways. This is particularly important for special education and technical subjects.

Learning to Elearn Principle 4

> ***There is a direct and proven correlation between the variables limiting the optimisation of individual and collaborative elearning outcomes and the variables affecting organisational learning, agility and competent performance.***

Research by EduArt on EduPuzzles™ also suggests underperforming or disruptive students are more likely to be engaged by, and undertake, learning that is experiential. This can occur where an interactive learning process is provided and the student has to apply learning to solve problems. Engagement can be enhanced by presenting problems in a manner that accommodates the student's learning style.

Learning to Elearn Principle 6

> ***Electronic learning (elearning) can be defined as a learning experience involving the acquisition, generation and/or transfer of knowledge delivered or transacted by electronic means.***

A step beyond CD-ROMs, interactive whiteboard technology is also beyond solely web-based or online learning. A combination of the second wave of elearning and the move of elearning into the classroom will blend the best of both teacher-led and virtual environments.

Learning to Elearn Principle 7

> ***Elearning is an activity that inherently involves service exchanges between humans moderated by technology in an electronic context.***

EduArt believes the correct utilisation of interactive whiteboard technology in the classroom will increase the morale of the students and teachers, moderate classroom behaviour and ultimately improve the interaction between the teacher and individuals in the class.

Learning to Elearn Principle 8

Elearning systems and architecture must support both the content delivery and the design, learning, evaluation and reporting processes for elearning.

To illustrate this principle, it may be helpful to compare small-screen software to interactive large-screen software.

EduArt believes there are fundamental differences in functionality between good small-screen software and that specifically designed for interactive whiteboards. This is not a criticism of small-screen software, but an explanation of why it is so important that both the pedagogical and technical issues be considered when designing software specifically for interactive whiteboards.

Small-Screen Software	Interactive Whiteboard Software
Made for individual use.	Made for use with large groups with class interactivity as the main focus.
Individually engaging and motivating. Usually using audio only as background and trying not to attract the attention of nearby users or annoy others.	Must quickly engage and motivate a large group. This requires new dynamics; audio loud enough for the whole class to hear, large-screen film production techniques and the ability to act in unison with the teacher or present as an independent character.
Much attention to functional detail. It must fully explain all functionality with buttons clearly displayed onscreen. Nothing can be hidden from the user as it needs to inform the individual in the most efficient way possible.	Can be more flexible in its use with some functions available only to the teacher; for example, hidden buttons to activate surprise board actions.
Individuals operating their own computers in a lab of computers make it very difficult for the teacher to maintain group attention on one outcome. Best for individual study or revision.	The teacher retains control of the board and thus maintains their authority to control the use of the computer and keep all attention on the one outcome. Best for group work or activities.
Software controlled by keyboard and mouse.	The ability to control the software from a distance using a handheld digital data display, by electronic pen on the board and from a computer with keyboard and mouse.
Graphic user interface (GUI) designed for a small screen with buttons arranged for viewing and easy access by mouse.	Graphic user interface (GUI) designed for a large screen with buttons arranged for ease of access by a person standing next to the screen. Thus factors such as 'left and right handedness', reach across the projected image and size of buttons relative to the whole screen become important. The GUI

Small-Screen Software	**Interactive Whiteboard Software**
	sometimes needs to be customised. *For example, software designed for small-screen use, like Word and PowerPoint, when displayed on a large screen can have oversized buttons along the top of the screen, well out of the reach of a young student! Such factors need to be considered when developing software for the larger screen*
No provision required for optical character recognition (OCR), as this type of interactivity is not possible.	Must provide for children and teachers to write on the board and to easily convert to type by OCR.
No provision required for an onscreen keyboard, as this type of interactivity is not possible.	Space needs to be provided for an adaptable onscreen keyboard for inputting. Sometimes the keyboard can float over the GUI, but in other cases it must become an integral part of the GUI to provide a permanent interface. Onscreen key boards may vary from the standard 'QWERTY' board typical on computers. Typing on a large board is not a two-handed process and thus other types of keypads need to be designed.
No provision required for drawing or sketching directly onto the screen.	An important part of many software packages will be the capability to draw circles, arrows and make notes. Another will be the interaction between students and software by drawing, especially important for primary school students.
No provision for wireless activation and interaction from a handheld data display unit.	Wireless handheld digital data display units allow the teacher to activate and interact with the board from anywhere in the classroom and while moving around the classroom. This means that the teacher is no longer required to stand up at the front of the class to control the board. They can be working with the class and still retain complete control of the board.
Provision for individual distance communication via the Internet.	Provision for distance communication between groups via distributed learning networks such as the Internet. With the large screen, students and teachers could share information with other classes anywhere in the world.

5. Contact Information

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Attachment 1
Bloom’s Taxonomy analysis for the Spectrum 7 science module on microscope elearning

Bloom’s Taxonomy ➔ Exercise ⬇	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
1. Building a Microscope	✓		✓			
2. Using a Microscope		✓	✓			
3. Making a Microscope Slide	✓	✓	✓			
4. Observe, Report and Measure	✓	✓	✓	✓		✓
5. Microscope Quiz	✓	✓	✓	✓		✓
6. Crossword Puzzle	✓	✓	✓			